

Original Research Article

A Study to Evaluate the Role of High-Resolution Computed Tomography of Temporal Bone in Pre-Operative Assessment of Ossicular Chain Status in Chronic Otitis Media

Mohan Kumar Mili, Prakash Patel*, Sabrina Yasmin, Gayatri Goswami, Maitrayee Deb

Department of Otorhinolaryngology, Assam Medical College & Hospital, Dibrugarh, Assam

* Correspondence: Dr Prakash Patel (prpatel55555@gmail.com)

ABSTRACT

Introduction

Chronic otitis media (COM) is a prevalent condition that can lead to ossicular chain damage and hearing loss. High-resolution CT (HRCT) scans play a crucial role in assessing the extent of disease and ossicular chain status. This study aimed to evaluate the role of HRCT temporal bone in preoperative assessment of ossicular chain status in COM patients.

Methods

This prospective observational study included 62 patients with COM who underwent HRCT temporomastoid scans. After applying inclusion and exclusion criteria, 47 patients were analyzed. HRCT scans were evaluated for malleus, incus, and stapes erosion. Surgical interventions were planned based on radiological findings and disease pathology.

Results

The majority of patients (83%) had squamosal COM, while 17% had mucosal COM. Incus erosion was most common (60%), followed by stapes superstructure erosion (21%). Malleus was relatively resistant to erosion (15%). Ossicular chain discontinuity was observed in 60% of cases. In squamosal COM, varying degrees of ossicular chain damage were seen, with only 15% of cases having an intact chain.

Conclusion

HRCT temporal bone is a valuable tool for preoperative assessment of ossicular chain status in COM patients. Squamosal COM is associated with a higher incidence of ossicular erosion, particularly incus and stapes. HRCT scans help plan surgical interventions and improve outcomes.

Keywords: High resolution CT (HRCT), ossicular chain, COM (chronic otitis media)

INTRODUCTION

High-Resolution Computed Tomography (HRCT) images taken with a multichannel scanner are now the standard of imaging for the temporal bone.¹ Chronic otitis media (COM) occurs due to permanent abnormality of the pars tensa or flaccida, most likely a result of acute otitis media (AOM), negative middle ear pressure, or otitis media with effusion. COM is classified into Healed COM, Inactive (mucosal) COM, Inactive (squamous) COM, Active

(mucosal) COM, Active (squamosal) COM. High-resolution CT scanning in both coronal and axial planes of temporal bone is proposed in the pre-operative assessment of cholesteatoma. A CT scan helps to assess the extent of disease in partially aerated mastoid.²

CT scans help to diagnose specific otological pathologies (e.g. AOM, COM, Cholesteatoma) by revealing erosion of the ear ossicles, the bony plates covering the sigmoid sinus, cerebellum, or tegmen of the middle ear, mastoid and bony labyrinth. Ossicular erosion is more common in squamosal

COM than in mucosal COM.³ long process of incus and stapes supra-structure are the commonly involved ossicles.⁴ Attico-antral/squamosal chronic otitis media always involves incus. Erosion of long process of incus with stapes arch is the most common ossicular chain defect.⁵ Disease that causes disruption of the ossicular chain leads to hearing loss, which can be of different grades depending on the amount of destruction of ossicles. The aim of this study was to evaluate the role of high-resolution CT temporal bone in pre-operative assessment of ossicular chain status in chronic otitis media patients.

MATERIALS AND METHODS

This was a prospective observational study that was conducted among patients presented with chronic otitis media to the department of otorhinolaryngology, Assam Medical College Dibrugarh and undergone radiological examination (High-Resolution CT temporo-mastoid). The study period was from November 2023 to October 2024. A total of 62 patients were included in this study. Reports of pure tone audiometry of all patients included in the study were studied to assess the hearing level of patients. High-resolution CT scan reports were studied for the above period of time in patients with chronic otitis media. CT scans were conducted utilizing Philips CT scanners. Axial sections were obtained in the supine position for all patients, supplemented by coronal reconstructions. The acquired images were reviewed in both bone and soft tissue windows using Philips Dicom viewer software, encompassing axial and coronal views. Scans were mainly evaluated for the below mentioned areas of interest in this study.

- Malleus erosion
- Incus erosion
- Stapes erosion

All patients who have undergone surgery for chronic otitis media where a pre-operative high-resolution CT scan had been performed were included in the study. Patients with previous history of ear surgery and patients older than 80 years were excluded.

RESULTS

This study examined 62 cases of chronic otitis media (COM), but only 47 of them met with the inclusion criteria. Patients were categorized into 'mucosal' and 'squamosal' types based on medical history and clinical evaluation. The majority 39 (83%) had squamosal COM, while 8 (17%) had mucosal COM. The patient ages were below 80 years. The mean age came as 36.08 years with SD 14.76 (Figure-1). Nearly half (49%) of the patients fell within the 21-40 years age group. Males comprised 66% (31 cases) of the study, while females accounted for 34% (16 cases) (Figure-2).

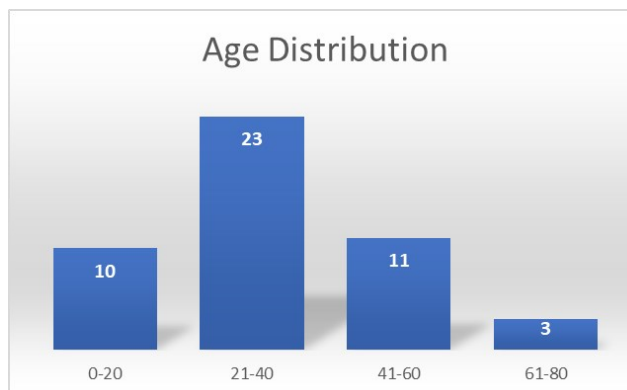


Figure-1: Distribution of patients according to age (in years)

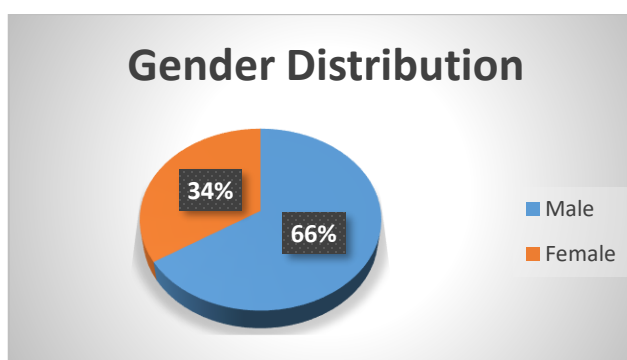


Figure-2: Distribution of patients according to gender

Malleus showed most resistance to erosion in chronic otitis media (COM). In our study, malleus was found to be intact in 39 (83%) of cases, eroded in 7 (15%), and absent in 1 (2%). Notably, in cases of mucosal COM, malleus was always intact. However, in squamosal COM, malleus was intact in 31 (79%), eroded in 7 (18%), and absent in 1 (3%) of cases. (Table-1).

Table-1: Status of malleus in COM

Malleus	Squamosal COM	Mucosal COM	Total
Intact	31 (79%)	8 (100%)	39 (83%)
Eroded	7 (18%)	0	7 (15%)
Absent	1 (3%)	0	1 (2%)
Total	39 (83%)	8 (17%)	47

Incus was the most commonly eroded ossicle in our study. We found incus intact in 19 (40%) of cases, eroded in 21 (45%), and absent in 7 (15%). However, in cases of mucosal COM, the incus was always found to be intact. In contrast, in squamosal COM, the incus was intact in only 11 (28%) of cases, eroded in 21 (54%), and absent in 7 (18%). Notably, the lenticular process of incus was the most commonly eroded part of bone. (Table-2).

Table-2: Status of incus in COM

Incus	Squamosal COM	Mucosal COM	Total
Intact	11 (28%)	8 (100%)	19 (40%)
Eroded	21 (54%)	0	21 (45%)
Absent	7 (18%)	0	7 (15%)
Total	39 (83%)	8 (17%)	47

Stapes bone was generally resistant to erosion, with 37 (79%) of cases showing an intact stapes. However, in 10 (21%) of cases, the superstructure of stapes was eroded due to disease. Notably, in cases of mucosal COM, no erosion of the stapes superstructure was observed. In squamosal COM, 29 (74%) of cases had intact stapes, 10 (26%) of cases showed erosion of the stapes superstructure. (Table-3).

Table-3: Status of stapes in COM

Stapes	Squamosal COM	Mucosal COM	Total
Intact	29 (74%)	8 (100%)	37 (79%)
Superstructure Eroded	10 (26%)	0	10 (21%)
Total	39 (83%)	8 (17%)	47

Ossicular chain (Malleus + Incus + Stapes) was found to be intact in 19 (40%) cases and discontinued in 28 (60%) cases. In cases of squamosal COM, varying degrees of ossicular chain damage were observed. Only 15% of cases (6 out of 39) had an intact ossicular chain (M+I+S). 13% (5 cases) had a malleus and stapes present but no incus (M+S+), 21% (8 cases) had a stapes but no incus & malleus (M-S+), 28% (11 cases) had malleus but no incus & stapes (M+S-), and 23% (9 cases) had no intact ossicles (M-S-). (Figure-3).

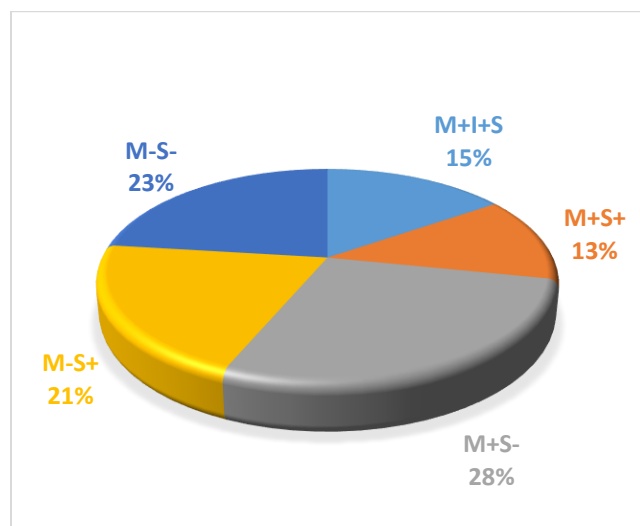


Figure-3: Ossicular chain status in squamosal COM

DISCUSSION

In this study, the HRCT temporo-mastoid of 47 patients were evaluated. Out of 47 patients 8 (17%) were diagnosed with mucosal COM and 39 (83%) were diagnosed with squamosal COM on the basis of clinicopathological studies. Individuals between the ages of 21 and 40 were disproportionately affected, with mean age being 36.08 years, a trend also observed in other research findings.⁶⁻⁹ In our study, the male to female cases ratio was 1.93:1, which was supported by the study done by Mahdiani S. et al.⁹

Malleus was found to be most resistant to erosion in chronic otitis media. In our study, malleus remained intact in 83% of cases, eroded in 15%, and absent in 2%. Notably, in mucosal COM, malleus was always intact (100%), whereas in squamosal COM, it was intact in 79%, eroded in 18%, and absent in 3% of cases, which was supported by a study done by Varshney S. et al.³ whereas, in a study done by Mohammadi G. et al. malleus was intact in 56% of squamosal COM cases.¹⁰

In our study, incus was most commonly eroded, with 45% of cases showing erosion and 15% showing absence. However, in cases of mucosal chronic otitis media (COM), the incus was always intact. In contrast, in squamosal COM, incus was often affected, with 54% erosion and 18% absence. Lenticular process of incus was most prone to erosion. Whereas Varshney S. et al observed erosion in 21.34% cases and absent incus in 17.33%.³ & Mohammadi G. et al. observed involvement of incus in 86.1%.¹⁰ 35% patients observed with incus eroded in study by Tripathi P. et al.¹¹

The stapes bone demonstrated significant resilience to damage, with approximately 79% (37 cases) retaining its integrity. However, 21% (10 cases) exhibited erosion of the stapes superstructure due to disease progression. A notable exception was observed in cases of mucosal COM, where no stapes erosion observed. In contrast, squamosal COM cases observed 74% (29 cases) with intact stapes, 26% (10 cases) with erosion of the stapes superstructure. Similar findings were observed in a study by Varshney S. et al. where stapes remained intact in 78.67% of cases of chronic otitis media, while 21.33% showed erosion of the stapes superstructure out of which 51.67% were cases of squamosal COM.³ In a study by Singh P. et al. erosion of stapes in 35.53% cases of COM was noted.¹² In our study, ossicular chain integrity was also assessed. Overall, 40% of cases had an intact ossicular chain, while 60% had disrupted ossicular chain, which was mainly observed in squamosal COM. Among the disrupted cases, damage varied: 15% had all three ossicles intact (M+I+S), 13% lacked incus (M+S+), 21% had only stapes (M-S+), 28% had only malleus (M+S-), and 23% had no intact ossicles (M-S-). Whereas in the study done by Varshney S. et al. intact ossicular chain were observed in 61.34%.³ In a study by Singh P. et al. 48.68%

of cases had an intact ossicular chain and 51.32% had a disrupted ossicular chain.¹² Among 111 patients of mucosal COM studied, Parmar M et al, observed incus erosion in 19 cases (17.1%). Malleus erosion was noted in 2 cases (1.8%), while stapes erosion occurred in 3 cases (2.7%)¹³. In a study done by Verma RB et al., the ossicular chain was eroded in 70.5% cases, 51.1% in mucosal COM cases and 86.7% in squamosal COM cases.¹⁴

Limitations in our study: The insufficient sample size poses a significant constraint, limiting the scope of analysis and hindering the identification of meaningful differences between components. As a result, definitive conclusions cannot be reliably drawn.

CONCLUSION

Our study revealed that, in chronic otitis media, malleus exhibits the greatest resistance to erosion, whereas incus is most prone to erosion. Furthermore, we observed a significantly higher incidence of ossicular erosion in cases of squamosal COM compared to mucosal COM. HRCT temporal bone plays a crucial role in addressing the challenge of delineating details of temporal bone anatomy (ossicular status) and pathology, thus aiding in more accurate diagnosis, assessment of extent of disease, earlier detection of complications, and thus helps in planning the management strategy for intemporal bone disease.

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